Anomalous posterior clinoid process and its clinical importance

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SUMMARY

The anterior, middle and the posterior clinoid processes are located in the middle cranial fossa of the skull. The posterior boundary of the pituitary fossa is formed by the dorsum sellae, the supero-lateral angles of which are raised to form the posterior clinoid process. Unlike the anterior clinoid process, the posterior clinoid process has received less attention in past research studies. The anatomy textbooks do not mention about the anomalies pertaining to the posterior clinoid process and the main source of information are the research reports. The present osteological study describes anomalous posterior clinoid process, detected in two human skulls, during routine undergraduate medical teaching and also discusses its clinical importance. The posterior clinoid process anomalies may be responsible for the altered arrangement of the tentorium cerebelli which is attached to it. The internal carotid artery is often explored by the neuro-surgeon and any bony abnormalities in its vicinity, would result in a difficult situation, while performing clinoidectomy operations. Anomalous posterior clinoid process, may compress the internal carotid artery. The close position of the superior petrosal sinus and the internal carotid artery to the posterior clinoid process, makes it vulnerable to injuries and thus it is important for the neuro-surgeons performing clinoidectomy operations. The anatomy of the posterior clinoid process may be important for neuro surgeons and radiologists in day to day clinical practice.

Keywords: *Anatomy; Skull base; Sella turcica; Cavernous sinus; Radiology.*

Importancia clínica de anomalías en los procesos clinoides posteriores

RESUMEN

Los procesos clinoides anterior, medio y posterior se localizan en la fosa media del cráneo. El límite posterior de la fosa pituitaria o silla turca lo constituye la lámina cuadrilátera del esfenoides = *dorsum sellae*, o dorso de la silla turca, cuyos ángulos supero-laterales se levantan para formar el proceso clinoides posterior. Al contrario del proceso clinoides anterior, el proceso clinoides posterior ha recibido menos atención en los estudios del pasado. Los textos de anatomía no mencionan las anomalías del proceso clinoides posterior y las principales fuentes de conocimiento son los informes de investigaciones. El presente trabajo osteológico describe anomalías del proceso clinoides posterior que se encontraron en dos cráneos humanos, en el curso de enseñanza médica de pre-grado y también discute su valor e interés clínicos. Las anomalías del proceso clinoides posterior pueden ser responsables de alteraciones en la disposición del *tentorium cerebelli* al que se adhiere. Con frecuencia el neurocirujano explora la arteria carótida interna y las anomalías óseas en su vecindad pueden resultar en situaciones difíciles mientras se hacen clinoidectomías. Un proceso clinoides posterior anormal puede comprimir la arteria carótida interna. Las estrechas cercanías que hay entre el seno petroso superior y el proceso clinoides posterior con la arteria carótida interna, hacen que este vaso sea vulnerable a posibles lesiones; esto es fundamental para las clinoidectomías que ejecutan los neurocirujanos. Además, la anatomía del proceso clinoides posterior es de importancia no sólo para los neurocirujanos sino también para los radiólogos en su práctica clínica de todos los días.

Palabras clave: *Anatomía; Base del cráneo; Silla turca; Seno cavernoso; Radiología.*

The anterior edge of the pituitary fossa is completed laterally by the middle clinoid process and the posterior boundary is formed by the dorsum sellae, the supero-lateral angles of which are expanded to form the posterior clinoid process[1]. The posterior clinoid process (PCP) is often removed to approach the upper basilar region and the posterior aspect of the pituitary fossa[2]. The cavernous sinus and the internal carotid artery are often explored for

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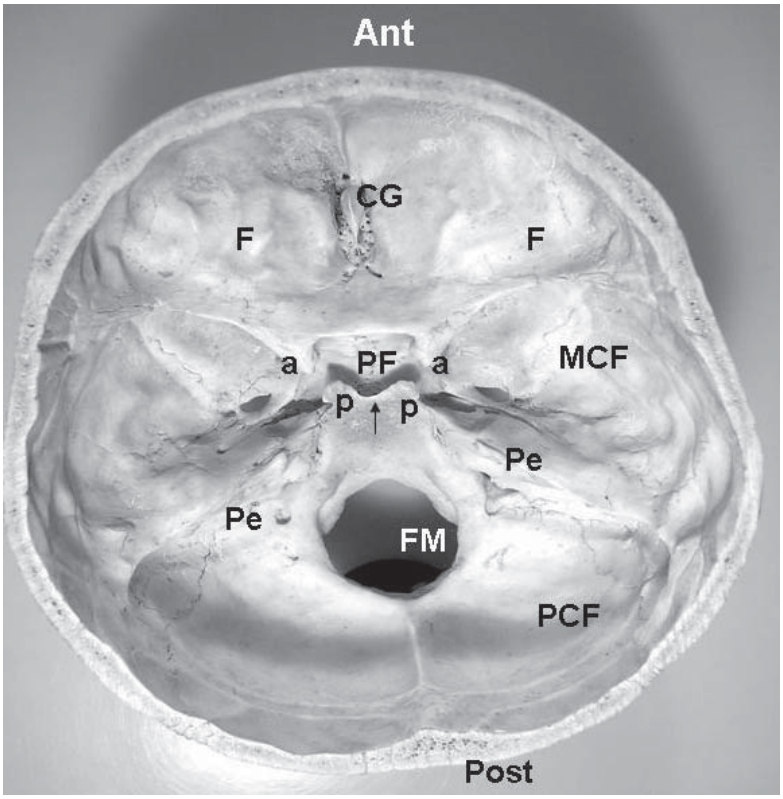

Photo 1. Photograph of interior of skull showing: F: Orbital plate of frontal bone. CG: Crysta galli. PF: Pituitary fossa. a: Anterior clinoid process. p: Posterior clinoid process. Pe: Petrous part of temporal bone. FM: Foramen magnum. MCF: Middle cranial fossa. PCF: Posterior cranial fossa. Ant: Anterior end. Post: Posterior end.

surgical operations and the complicated anatomy of this part of the skull makes it important for the surgeon to have a detailed detailed knowledge of the anterior, middle and the posterior clinoid processes and its possible variations. The main risk in these skull surgeries are injury to the anterior, middle and posterior clinoid processes, optic tract, and petrous temporal bone. Presence of bony bridges from the PCP joining spicules of the anterior clinoid process (ACP) have also been reported as dangerous complications during any anterior clinoidectomies[3]. In the present paper, abnormal spicules and projections from the PCP which were found in two osteological specimens of the dried human skull are reported. The authors as anatomists, presume that any spicules or projections from the PCP, may press upon the pituitary roof thereby causing compressive symptoms. A detailed description of the anomaly with its clinical associations, is being described in the present article.

CASE REPORT

During routine osteology teaching for undergraduate medical students, an anomalous PCP in two human skulls was observed. The anomalous PCP was carefully studied in detail, the appropriate morphometric measurements were taken and the specimen was photographed.

OBSERVATIONS

Case 1. The upward projected PCP was rounded and not pointed, as seen normally. There was a concave depression between the two PCPs (Photo 1).

PCP. The maximum transverse distance, 1 cm. The maximum height, 1 cm. The distance between ACP & PCP, 0.5 cm (left side) & 0.6 cm (right side).

Sella turcica. Apparently, the depth of the sella turcica seemed to be much more than normal.

Case 2. The PCPs were projecting upwards, very close to each other and displayed spicules on either sides. It was, as if two vertical projections were representing the PCPs (Photo 2).

PCP. The maximum transverse distance, 0.5 cm. The maximum height, 1.1 cm. The distance between ACP & PCP, 1 cm (left side) & 1 cm (right side).

Sella turcica. Apparently, the depth of the sella turcica seemed to be much more than normal.

DISCUSSION

The deeply concave sella turcica contains hypophysis cerebri. The anterior edge of the of the sellla turcica is completed laterally on either side by the middle clinoid process[1]. Posteriorly, the sella turcica is bounded by a square dorsum sellae, the superior edges of which bear the PCP[1]. Standard anatomy textbooks simply mention about the PCP without giving much details on its anomalies. In the present study, two abnormal cases were observed, where the PCP

was projecting upwards. The distance between the two PCP varied in the two cases suggesting a developmental abnormality. The vertical projections of the PCP as seen in the present case, may cause problems while performing clinoidectomy operations.

The ACP has received more attention because during neuro-surgical operations, for the simple reason that it has been used by the surgeons, to gain entry into the clinoid space[4]. The ACP has been reported to be joined to the middle clinoid process by a fold of dura mater[4]. The ACP, is thus important from the point of view of surgical operations involving the internal carotid artery. Often the ACP is cut out to perform such operations but the PCP is less accessed. Any outgrowth from the PCP may compress the surrounding neuro-vascular structures especially the internal carotid artery. The attachment of the tentorium cerebelli into the PCP may be hampered due to any abnormality in this region. Since the superficial petrosal sinus is also related to the region of the PCP, it is essential to have a previous good anatomical knowledge before exploring any of these structures i.e. internal carotid artery, superficial petrosal sinus, tentorium cerebelli, etc.

There is paucity of literature on the anomalies of the PCP. The clinical importance of the abnormal PCP as seen in the present case, may pose a risk during any drilling procedures involving the PCP while performing orbitozygomatic transcavernous-transclinoidal surgeries[5]. Surgeons have drilled the PCP and the dorsum sellae, in order to expose a length of basilar artery, that includes its bifurcation[5]. This route also gives a wider space to access the oculomotor nerve-carotid artery region. Considering the fact, that the upper anterior third of the posterior fossa is surgically hidden, the narrow passage between the petroclival surface anteriorly and the surface of the brainstem posteriorly may be essential for any surgical approach to the basilar region[2]. Many a times there are aneurysms in the artery and it is significant and of great consequence to have an anatomical knowledge of the PCP.

It is important for the neuro-surgeon to take

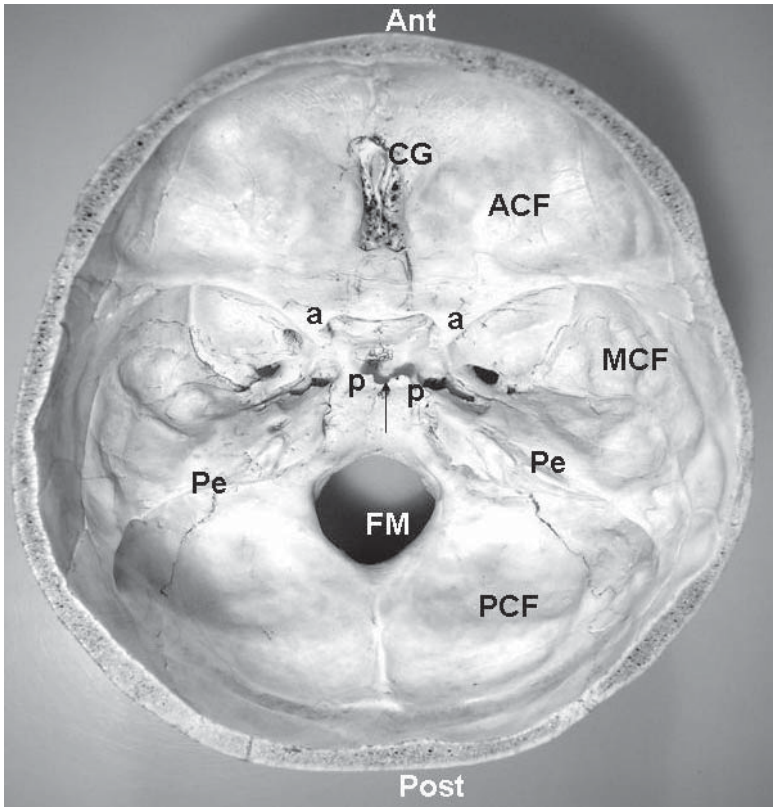

Photo 2. Photograph of interior of skull showing: CG: Crysta galli. PF: Pituitary fossa. a: Anterior clinoid process. p: Posterior clinoid process. Pe: Petrous part of temporal bone. FM: Foramen magnum. ACF: Anterior cranial fossa. MCF: Middle cranial fossa. PCF: Posterior cranial fossa. Ant: Anterior end. Post: Posterior end, The small depression between the two projected posterior clinoid processes is marked with arrow (-->).

prior measurement of the distances between the entrance of the oculomotor and trochlear nerves and the PCP may have to be taken to gain entry to the structures deeper to the cavernous sinus[6]. The presence of any bony bridge connecting the PCP to surrounding structures has been considered to be dangerous especially for anterior clinoidectomy operations[3]. Perhaps, this is the reason why CT is advised ahead to such operations, so as to have pre-operative planning[3].

The attachment of the dura to the PCP may also be stretched in abnormalities involving this region. Resection of anomalous PCP may also result in the unnecessary tearing of the dura. The anomaly of the PCP may also pose an additional obstacle while performing clinoidectomy operations and there are chances of inadvertent injury to the internal carotid artery, the oculomotor and the trochlear nerves.

An interesting research report had described persistent primitive trigeminal artery variant penetrating the lateral edge of the PCP, perforating the canal of the PCP and the petrosal bone junction[7]. Proximity of the blood vessels may cause unnecessary bleeding, if not handled properly.

Surgical operations on the basilar aneurysms below the PCP need preoperative planning. The removal of the PCP and the portion of the dorsum sellae that is exposed from within the cavernous sinus has been described as a possible method to operate and treat low-lying distal basilar artery aneurysm[8]. Anatomical variations of the PCP may also encroach to pituitary gland to cause resultant symptoms. The greater depth of the sella turcica in both the skull bones, clearly suggest of some developmental anomaly.

CONCLUSIONS

The authors as anatomists, opine that anatomical knowledge of PCP may be clinically important for surgeons operating in the region of cavernous sinus or the surrounding structures. Prior radiological investigations may be helpful for pre-operative planning. Presence of any abnormality may result in unnecessary injury to the complicated neurovascular structures in the vicinity of cavernous sinus.

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